5

5

1. A varactor comprising:

a diode junction;

a depletion region adjacent to the diode junction; and

a doped region including the depletion region and having a

nonuniform dopant concentration profile that increases with increasing depth of the doped region from the diode junction;

and wherein the nonuniform dopant concentration profile causes the varactor to have an approximately linear capacitance/voltage response characteristic.

2. A varactor as defined in claim 1 wherein:

the doped region includes a peak dopant concentration region outside the depletion region; and

the peak depant concentration region forms a conductive path to and from the varactor.

3. A varactor as defined in claim 1 wherein:

the nonuniform dopant concentration profile is defined by an equation N=Bxm, where N is the dopant concentration, x is the depth of the doped region, B is a concentration constant and m is an exponent that determines the degree of curvature of the dopant profile.

- 4. A varactor as defined in claim 3 wherein m is greater than zero.
- 5. A varactor as defined in claim 3 wherein m is about 3.
- A varactor as defined in claim 3 wherein:B is in a range from about 1.0E13/cm3 to about 1.0E19/cm3; and m is greater than zero.
- 7. A varactor as defined in daim 6 wherein B is about 1.0E16/cm3.
- 8. A varactor for use in an integrated circuit comprising: a semiconductor substrate;

a first side formed in the semiconductor substrate and being doped with a first type of dopant in a retrograde dopant profile;

5

5

10

4 10 10

a second side formed in the semiconductor substrate adjacent the first side and being doped with a second type of dopant; and

a depletion region formed within a portion of the first side adjacent the second side upon applying a voltage bias between the first side and second side, the voltage bias also causing a capacitance between the first side and the second side that is linearly variable with the voltage bias.

9. A varactor as defined in claim 8 wherein:

the retrograde profile of the first type of dopant in the first side includes an increasing dopant concentration with increasing depth from the second side to a peak concentration region; and

the peak concentration region functions as a conductive path to and from the varactor.

- 10. A varactor as defined in claim 8 wherein:the first side is a generally horizontal bottom side; andthe second side is a top side generally parallel to the bottom side.
- 11. A method of forming a varactor in a semiconductor substrate comprising:

forming a first doped region of a first dopant type with a nonuniform dopant concentration profile from a low-doped end of the first doped region to a high-doped end of the first doped region;

forming a second doped region of a second dopant type adjacent the low-doped end of the first doped region;

forming a dibde junction between the first and second doped regions; forming a depletion region in the first doped region adjacent the second doped region by reverse biasing the diode junction; and establishing a capacitance between the first and second doped

12. A method as defined in claim 11 further comprising:
forming a conductive path to and from the varactor through the high-doped end of the first doped region.

regions that is approximately linearly related to the reverse biasing.

- 13. A method as defined in claim 11 further comprising:
 forming the first doped region with the nonuniform dopant
 concentration profile defined by an equation N=Bxm, where N is the dopant
 concentration, x is the depth of the doped region, B is a concentration constant
 and m is an exponent that determines a degree of curvature of the nonuniform
 dopant concentration profile.
 - 14. A method as defined in claim 13 wherein m is greater than zero.
 - 15. A rhethod as defined in claim 13 wherein m is about 3.
 - 16. A method as defined in claim 13 wherein:

 B is in a range from about 1.0E13/cm3 to about 1.0E19/cm3; and m is greater than zero.
 - 17. A method as defined in claim 16 wherein B is about 1.0E16/cm3.